

Application No. 10/645,429

reactors, internals and their auxiliary components), unless specialized metallurgy and/or other costly materials of construction are used. In either event, how the corrosiveness of the maleic acid is addressed in the commercial plant's design, procurement, construction, operation and maintenance has a major impact on process economics of a maleic acid to 1,4-butanediol chemical plant and hence its commercial viability. Applicants observed that maleic acid is very corrosive at temperatures exceeding approximately 140°C, but that at temperatures less than about 130°C, the corrosion was minimized. Other testing by Applicants confirmed that the hydrogenation of maleic acid to succinic acid would proceed at acceptable rates at temperatures less than about 130°C. The process of the present invention lessens the corrosive effects of the maleic acid feedstock, while maintaining good conversion of maleic acid to succinic acid in the first hydrogenation step..

Applicant's invention is a two-stage continuous process for the hydrogenation of maleic acid to 1,4-butanediol (BDO), gamma-butyrolactone (GBL) and/or tetrahydrofuran (THF) in a process comprising two hydrogenation zones wherein the temperature of the feedstream comprising maleic acid and the temperature of the first hydrogenation zone are controlled such that the temperature of the maleic acid in the feedstream and the first hydrogenation zone does not exceed about 130°C.

35 USC § 112, First Paragraph Rejection

Claims 1-13 are rejected under 35 U.S.C. 112, first paragraph.

The Examiner states that the specification, while being enabling for hydrogenation catalyst of Group VIII of the Periodic Table does not reasonably provide enablement for any and all catalysts, that the specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected to make and use the invention commensurate in scope with these claims, and that a hydrogenation reaction employing any and all catalysts is not properly supported in the specification.

Applicants respectfully traverse this rejection.

The primary feature of Applicants' invention is the temperature range claimed for the first reaction zone. The invention requires that both the temperature of the feedstream comprising maleic acid and the temperature of the first hydrogenation zone be controlled such that the temperature of the maleic acid in the feedstream and the first hydrogenation zone does not exceed about 130°C. The purpose of this is to reduce corrosion that can occur with a maleic acid feed at higher temperatures.

The disclosure at page 6, line 14, to page 7, line 12, of the Specification describes the type of catalysts suitable for use in the claimed process. It can be seen from this

Application No. 10/645,429

disclosure that "any and all catalysts" are not taught as useful. This disclosure on pages 6 and 7 of the Specification relating to the catalysts which may be use in practicing the process would enable one skilled in the art to choose a catalyst suitable for use in the claimed process.

35 USC § 112, Second Paragraph Rejection

Claims 1-16 are rejected under 35 U.S.C. 112, second paragraph.

The Examiner states that Claims 1-16 are indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, that the claims recite a series of process steps to produce gamma-butyrolactone, 1, 4-butanediol and/or tetrahydrofuran from hydrogenating maleic acid and hydrogen in the presence of a catalyst, and that it is not clear what conditions have to prevail to produce either gamma-butyrolactone alone or 1,4-butanediol or tetrahydrofuran or a combination of the above. Are all the products being produced in equal amount, and if not what are the ratios or amounts of each product.

Applicants respectfully traverse this rejection.

As stated above, the primary feature of Applicants' invention is the temperature range claimed for the first reaction zone. The temperature of the maleic acid feedstream and the first hydrogenation zone are controlled so that the temperature does not exceed 130°C in order to minimize corrosion caused by maleic acid in the reactor piping and in the reactor.

The disclosure under the heading "The Process" at page 7, line 13 to page 9, line 23 describe the process and states that "The effluent from the second hydrogenation zone, predominately 1,4-butanediol, unreacted hydrogen and water with minor quantities of tetrahydrofuran, gamma-butyrolactone and other by-products." (See page 9, lines 10-12. In addition, at page 9, lines 21-22, the Specification states that "The yields of 1,4-butanediol achieved are about 80 mole percent or greater, typically about 90 mole percent or greater."

Applicants submit that there is nothing indefinite about Claims 1-16. One skilled in the art would know from reading the specification what is being claimed. As stated before, the main point of the invention is to control the temperature in the first reactor to minimize corrosion caused by the maleic acid feed. There is no requirement to claim the specific ratios of 1,4-butanediol, gamma-butyrolactone, and tetrahydrofuran produced in order for the claims to particularly point out and distinctly claims the subject matter which applicants regards as the invention.